Mercury

Symbol:	**Hg**
Atomic Number: *(protons in nucleus)*	**80**
Atomic Weight:	**201**

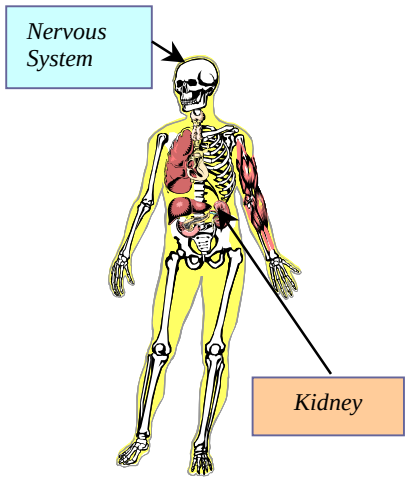
What Is It? Mercury is an element that occurs naturally in the environment, usually in combination with other elements as mercury compounds or salts. Metallic mercury is a shiny, silver-white metal that is a liquid at room temperature. If heated, it enters the atmosphere as a colorless, odorless gas. Mercury combines with other elements to form inorganic mercury compounds, some of which are soluble in water. It also combines with carbon to form organic mercury compounds, such as methylmercury. Because it is an element, mercury does not degrade nor can it be destroyed.

How Is It Used? Metallic mercury is used to produce chlorine gas and caustic soda and to extract gold from ores. It is used in thermometers, dental fillings, and batteries. Some inorganic mercury compounds are used in skin-lightening creams, as antiseptic creams and ointments, and as anti-mildew agents.

What's in the Environment? The most common forms of mercury that occur naturally in the environment are metallic mercury; the inorganic salts, mercuric sulfide and mercuric chloride; and methylmercury. Microorganisms and various natural processes can change the form of mercury in the environment: metallic mercury can combine with other elements to form inorganic mercury compounds, and inorganic mercury compounds can combine with carbon to form organic mercury compounds. In turn, organic mercury compounds can be changed to inorganic compounds. Methylmercury is the most common form created by these natural processes. This compound is of particular concern because it can bioaccumulate through the food chain. That is, small organisms and plants take up methylmercury as they feed, animals higher up the food chain eat these plants and organisms, and the process continues with levels of methylmercury increasing up the food chain. Of particular concern is the bioaccumulation of mercury in fish and shellfish in which concentrations of mercury can be much higher than in the surrounding water and than in fish lower in the food chain. However, mercury does not bioconcentrate in terrestrial plants; the typical ratio of the concentration in plants to that in soil is estimated at 0.2 (or 20%). In the United States, the concentration of mercury in soil containing natural levels of mercury ranges from less than 0.02 to about 6 milligrams of mercury per kilogram of soil (mg/kg). Mercury leaches somewhat slowly, with a concentration in soil particles estimated to be about 10 to 100 times higher than in the water between the soil particles. In air, concentrations of mercury range from about 0.01 to 0.02 microgram per cubic meter ($\mu g/m^3$).

What Happens to It in the Body? Mercury can be taken into the body primarily by breathing air, eating food, or contacting the skin. How much mercury enters the body and what happens depends on the form of mercury and the route of exposure (that is, through air, food, or skin). When vapors of metallic mercury are inhaled, as much as 80% is absorbed. Following ingestion, absorption is less than 0.01% for metallic mercury, less than 10% for inorganic mercury, and greater than 95% for organic mercury. Mercury can also be absorbed through the skin, but the amount is small compared to breathing or swallowing it.

Once in the body, metallic mercury and organic mercury compounds easily reach most tissues, including the brain; mercury also reaches the fetus of a pregnant woman. Mercury accumulates in the kidneys. In the brain, metallic mercury and methylmercury can be converted to an inorganic form that is then trapped in the brain. Mercury tends to stay in the body for weeks or months. Eventually, mercury leaves the body through the urine and feces.



Organs and systems affected when mercury is taken in through food, water, or air.

What Are the Primary Health Effects? The nervous system is very sensitive to all forms of mercury, although the brain is most sensitive to metallic mercury and methylmercury because they enter the brain more easily than inorganic mercury. Exposure can cause tremors; memory loss; and changes in personality, vision, and hearing. (As a note, the Mad Hatter in the book *Alice in Wonderland* displays personality changes noticed during the 1800s to early 1900s in people engaged in the hat-making business in which mercury was used to process leather.) Children and fetuses are particularly sensitive to the harmful effects of mercury on the nervous system; exposure can result in mild to severe brain damage, including effects on a child's behavior and ability to think and learn. Mercury also damages the kidneys. Although studies in animals indicate that mercuric chloride and methylmercury can cause cancer in laboratory animals, we do not know if they can cause cancer in humans ingesting these compounds or breathing them in air. On the basis of the animal studies, the Environmental Protection Agency (EPA) identifies both mercuric chloride and methylmercury as possible human carcinogens.

What Is the Risk? The EPA has developed toxicity values to estimate the risk of developing non-cancer effects as a result of inhaling or ingesting mercury *(see box below)*. The toxicity value for estimating non-cancer effects is called a reference dose (RfD), which is an estimate of the highest dose that can be taken in every day without causing an adverse non-cancer effect. These toxicity values have been developed by studying test animals given relatively high doses of mercury over their lifetimes, then adjusting and normalizing those results to a mg/kg-day basis for humans.

Chemical Toxicity Values

Form of Mercury	Non-Cancer Effect	
	Oral RfD	***Inhalation RfD***
Metallic mercury	None established	0.000086 mg/kg-day
Mercuric chloride	0.0003 mg/kg-day	None established
Methylmercury	0.0001 mg/kg-day	None established
Phenylmercuric acetate	0.00008 mg/kg-day	Assumed to be the same as for ingested phenylmercuric acetate

To illustrate how the RfD may be applied, a 150-pound (lb) person could safely ingest 0.001 mg of methylmercury every day without expecting any adverse effects (2.2 lb = 1 kg, 1,000 g, or 1 million milligrams).

What Are Current Limits for Environmental Releases and Human Exposures? To help track facility releases to the environment, the Superfund amendments addressing emergency planning and community right-to-know require that releases of certain chemicals to air, water, or land be reported annually and entered into a nationwide Toxic Release Inventory. Several mercury compounds are regulated under those amendments. Reportable quantities are 1 lb (0.454 kg) for mercury and mercuric cyanide; 10 lb (4.54 kg) for mercuric nitrate, mercuric sulfate, mercuric thiocyanate, mercurous nitrate, and mercury fulminate; and 100 lb (45.4 kg) for phenylmercuric acetate.

The EPA has established a limit of 0.002 milligram per liter (mg/L) for mercury in drinking water. Mercury is not regulated under the Clean Air Act. For air in the workplace, the Occupational Safety and Health Administration has set a permissible exposure limit (PEL) of 0.1 milligram per cubic meter (mg/m^3) for inorganic mercury vapor, and 0.01 mg/m^3 for organic mercury compounds. The Food and Drug Administration has set an action level in fish and shellfish of 1 mg of methylmercury per kg of fish.

Where Can I Find More Information? More information on mercury can be found in the primary information source for this overview: the Toxicological Profile for Mercury prepared by the Agency for Toxic Substances and Disease Registry and available on the Internet at http://www.atsdr.cdc.gov/toxpro2.html. Several other sources of information are available on the Internet, including the ATSDR ToxFAQS (http://www.atsdr.cdc.gov/toxfaq.html), EPA's Integrated Risk Information System Database (http://www.epa.gov/iris/subst/index.html), and the Hazardous Substances Data Bank (http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB).